across country with his whole army. The forenoon was hot, and not a cloud was to be seen. Presently, the magicians noticed on the horizon a peculiarly shaped cloud:—"It rose rapidly in one mass and 'rolled upon itself.' Its movements were intently watched till it approached the zenith and passed over the sun. This was an evil omen. For some unknown cause the spirits were mortally offended, and had come over the army in shadow at noonday. In grief and sorrow their backs were turned upon their children, and the result of this would be certain defeat and disaster. There was, however, no immediate danger. That morning's scouts had reported that there were no troops within many miles of their line of march, and they could repair to some sacred place to offer sacrifices and make atonement. While they were discussing which place to repair to for this purpose, the van of a small column of cavalry appeared unexpectedly over a rising ground. Dismay struck into every heart. The war minister urged his men to form into order of battle. No one answered his summons. He did his best to organize an orderly retreat, but in vain; not a blow was struck, and every man took to his heels, making for the nearest hiding-place in mountain or forest. That army never reassembled. Black-hearted fear utterly demoralized it."

Water or river spirits play a great part in South African mythology. They inhabit deep pools where there are strong eddies and under-currents. They are dwarfs, and are of a malignant disposition, which they display by greedily seizing on anyone who comes within their reach. They are, of course, greatly feared; and the popular dread of them is shown in a way which has been known in many different parts of the world. Mr. Macdonald gives the following example:—

"Some years ago a number of Gcaleka girls were, on a fine summer day, bathing in the Bashee. One of them got beyond her depth, and began to struggle in the water and cry for help. Her companions promptly raised the alarm, and two men working close by ran down to the water's edge. She was still struggling feebly, but to the onlookers it was a clear case of being 'called' by the river, and they made no attempt to save her. The body was recovered by the magicians the same day, when it was found she had been drowned in less than 5 feet of water. All this came to the ears of C. G. H. Bell, Esq., the English Resident, and he cited the parties, magicians and all, to appear before him in court. The two men not only admitted that they could have waded to the spot where they saw her struggling, but also said the water would not be 'more than breast deep.' They had made no effort to save her, as it would be 'improper and dangerous to interfere when one is called by the river.' Mr. Bell tried to argue them out of such absurd notions, but to little purpose, and finally came to the conclusion that 'six months hard' might be more effectual in eradicating superstition than all his philosophy, and six months hard it accordingly was."

Mr. Macdonald says there is no periodical process of purging or driving away spirits. Without the presence and aid of magicians, ordinary people dare not interfere with these mysterious powers, however malignant and destructive they may become. Although a man is guarded by the spirits of his ancestors, they do not protect him from demons or from wizards and witches. A certain measure of protection can, however, it is supposed, be obtained by the use of charms provided by magicians. On one occasion, when war was being carried on with England, the magicians gave the soldiers a charm against English bullets. It was the blue flower of a species of rhododendron. "Those who carried this talisman rushed forward against columns of infantry without a shadow of fear or hesitation, and only when men began to bite the dust in all directions did the nature of the delusion break upon the army, and panic ensue."

THE ACTION OF LIME ON CLAY SOILS.

THAT lime promotes the fertility of heavy clay soils is a fact that has for many generations been well known to all agriculturists; but the scientific reason for the beneficial action arising from its application has not, to the best of my belief, been at any time at all satisfactorily explained. The question, however, remains one of first importance in the science of soils, and I therefore make no apology for offering an explanation, or rather theory, which, to my doubtless somewhat partial mind, seems to go a considerable way towards the elucidation of the problem.

I take it for granted that all interested know that a clay soil is not by any means a pure clay (hydrated silicate of alumina), but a mixture of *impure* with pure clay (much more of the former than of the latter), plus sand, iron oxides, organic matter, &c. The clays which form its bulk have been derived from the natural decay or weathering of mineral silicates, containing, besides, aluminium, alkali, or alkaline-earth metals, and they occur in it in all stages of impurity or further decomposition. As an invariable rule, other things being equal, the greater the normal impurity of the clays the greater the fertility of the soil. A *pure* piece of clay is like pure quartz-sand—so much dead, inert matter; a plant can make nothing of it, can take nothing from it. In no fertile clay soil, however, even of the heaviest description, does there occur at any time more than about 10 per cent. of *absolutely* pure clay. Well, then, what is the composition of the average clay particle? That depends on the mineral from which it was derived. If from the felspars, its most common origin, it will be a hydrated silicate of alumina plus silicate of potash, or, instead of the potash, soda and lime. I will suppose, for brevity's sake, that my clay particles have the former composition, and the explanation which I will offer with regard to their behaviour can be applied with very little difficulty to any of the other cases. Clay particles of the above composition, when subjected to the action of water containing carbonic acid gas, lose potash. That I have repeatedly proved by experiment. If the carbonic acid is in fair excess, it comes away altogether as carbonate of potash; but if there is not a sufficiency of this anhydride, it is liberated partly as soluble silicate of potash (soluble glass). Should lime, however, in this latter case be present, the practically insoluble calcium silicate will be constituted, and the potash freed to form a soluble salt with any other acid that may be present and available, such as carbonic, sulphuric, nitric, &c. A grass plant growing in clay soil does not, it is evident, send sufficient carbonic acid through its root-hairs into the soil, as many other plants do, to completely convert the liberated potash into carbonate, and the consequence is that the soluble silicate of potash which is permitted to form is drawn into the vegetable, as well as the carbonate of that alkali. Now silica and silicates are decidedly injurious, to all vegetables doubtless, but particularly to agricultural plants. I say injurious; the day has gone by for considering silica an essential, or useful, or even a merely innoxious accessory. A little examination of the plant-physiology shows that it is injurious. The organism tries to get rid of it as speedily as possible—that is, at least to get it out of the way of its general circulation; it unfortunately has no means of casting it off altogether. Here, I need scarcely refer to the well-known experiments which have, over and over again, conclusively shown that the grass plant does not require silica as a supporting or strengthening material. Now we come to see the use of lime in the clay soil, especially in the case of the cultivation of cereals and pastural grasses. The lime added and mixed up with the soil acts on the soluble silicate of potash as it is formed, and combines with the silica, constituting, as I have already remarked, the practically insoluble silicate of lime, which, of course, being normally indissolvable in the soil, cannot pass into the body of the plant. Therefore, the organism profits by its exclusion, and as a consequence so does the farmer. The energies of the plant are not spent in getting rid of silica if there is no silica to get rid of, and its ordinary processes of nutrition can progress uninterruptedly.

The breaking up of the soluble silicate[1] could be as well accomplished by the perfect aëration of the soil so that every particle could be constantly exposed to fresh portions of aërial carbonic acid and oxygen; and this is one great reason why fine deep tillage, where it is possible, so improves clayey soils, but of course a tillage that will bring about the perfect aëration of heavy clay, is all but impossible; therefore the advantage of judiciously using lime.

The soluble alkaline silicate which, when undecomposed, passes into the plant in the water-stream through the roots, is evidently very soon split up by the vegetable, and the silica combined with some substance, such as an aldehyde, and carried on in solution in this state to the peripheries of the stem, &c., where, by the process of practically unrestrained evaporation, the compound is again split up, the aldehyde going off into the air, and the solid silica remaining stranded in the cuticle and the other walls, or occasionally even in the cavities of the epidermal layer.

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[1] Only the alkali metals, of which potassium and sodium are the only two that normally occur in soils, form silicates soluble in water.

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The silicate of lime formed in the above reaction itself ultimately undergoes decomposition by natural water containing carbonic acid, but the decomposition is always complete; it devolves entirely into carbonate of lime and free insoluble silica.

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UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof. Sylvester is lecturing this term on the theory of numbers, and its application to the division of the circle into equal parts. Prof. Clifton and Mr. Baynes lecture on electricity, and Mr. Walker on physical optics. Prof. Odling's course is on ureas and uric acid, and Mr. Veley is lecturing on physical chemistry.

Prof. Ray Lankester is giving a general course on morphology, and Mr. Minchin a special lecture on Echinoderms. Dr. W. Benham has been appointed Demonstrator in the Morphological Laboratory in succession to Mr. P. C. Mitchell, who has been selected by the University Extension authorities as one of the lecturers who are to carry out the scheme of scientific education adopted by the County Council of Devonshire.

An examination for a Radcliffe Travelling Fellowship will take place before the end of Term. The Senior Mathematical Scholarship has been awarded to Mr. A. L. Dixon, Worcester College.

CAMBRIDGE.—The General Board of Studies announce the vacancy of the Lectureship in Advanced Morphology of Invertebrates, caused by the appointment of Mr. Weldon, F.R.S., to the Chair of Zoology in University College, London. The appointment is for five years, and the stipend £50 a year. Candidates are to apply to Prof. Sidgwick, Hillside, Cambridge, by February 3.

Prof. Macalister announces an introductory lecture on Thursday, January 29, at noon, by way of inaugurating the new anatomical lecture-theatre. His subject is "The History of Anatomical Study in Cambridge."

Prof. Roy announces six courses of lectures for the Lent and Easter terms in pathology and bacteriology, to be given by himself in collaboration with Mr. J. G. Adami, John Lucas Walker Student; Mr. E. H. Hankin, Fellow of St. John's; Dr. A. Gamgee, late Professor of Physiology at Owens College; and Mr. E. Lloyd Jones, Demonstrator of Pathology.

Prof. Ewing will lecture for the present in Sir George Stokes's lecture-room at the new Museum. He announces courses in strength of materials, theory of structures, mechanics, and geometrical and mechanical drawing.

The Botanic Garden Syndicate report that, while the new range of plant-houses, erected at a cost of £3000, has proved very satisfactory, it has been discovered that the remaining old houses are in a hopeless state of decay, and cannot with advantage be longer maintained. They propose that they be reconstructed at a cost of £2200.

The Special Board for Biology report that, during the five years ending Michaelmas 1890, the University's table in the Zoological Station at Naples, for which an annual grant of £100 has been made to Dr. Dohrn, has been occupied on eight occasions by Cambridge workers. In view of the importance of the opportunities there offered, and of the recent extensions and improvements that have been made, the Board propose that the grant be renewed for a further period of five years.

Dr. J. Griffiths, Assistant to the Professor of Surgery, is nominated an additional member of the Board for Medicine; Mr. W. N. Shaw, of the Board for Physics and Chemistry; Mr. S. F. Harner, of the Board for Biology.

Mr. T. Roberts and Mr. Acton, of St. John's, and Mr. Wilberforce, of Trinity, are appointed Examiners in Natural Science, in connection with the University Extension Scheme.

SCIENTIFIC SERIALS.

American Journal of Science, January.—On the alternating electric arc between a ball and point, by Edward L. Nichols. Let two wires, forming the terminals of the secondary coil of an alternate current transformer, be brought nearly into contact, one of them being armed with a point, the other with a ball. When the distance is such as to admit of a discharge between the two, a galvanometer in shunt around the ball and point will be found to indicate a considerable flow of continuous current, the direction being that which would result from a current flowing from the former to the latter. This phenomenon has recently been subjected to experiment by Messrs. Archbold and Teeple, who have determined the changes of electromotive force and current as the length of the arc formed between the ball and point is increased. Mr. Nichols also describes some observations made by Mr. F. C. Caldwell, from which it appears (1) that the discharge from the ball (positive) leaves the latter in a direction normal to the surface, but that it enters the other terminal at some distance from the apex; (2) that the discharge from the point (positive) leaves the apex of the latter, but is deflected into a course nearly 45° from the axis, and reaches the ball obliquely at some point on its side.—Deformation of the Algonquin Beach, and birth of Lake Huron, by J. W. Spencer.—The decimal system of measures of the seventeenth century, by Prof. J. Howard Gore. Evidence is adduced (1) that a priest, named Gabriel Mouton, of Lyons, proposed a system of measurement, based upon the scale of tens, about 1665; (2) that he derived his unit from the length of a minute of the terrestrial arc; (3) that he showed how this unit could be expressed in terms of the seconds pendulum.—On the Clinton Oolitic iron ores, by A. F. Foerste.—Effects of pressure on ice, by R. W. Wood, Jun. A solid steel piston was turned to work air-tight in a cylindrical cavity drilled in a block of cast-iron. A small hole, like the vent of a cannon, communicated with the bottom of the cavity. Ice was placed in the cavity, and the piston inserted. At a pressure of 4½ tons to the inch, small cylindrical pieces of clear ice spurted from the orifice. To test at what pressure ice at the melting-point would become fluid as a mass, a similar iron block, without a vent, was filled with ice, in which were embedded several small bullets. The pressures were carried up to twenty tons per square inch without the ice being reduced to a liquid state. When this point was reached, fine jets of spray spurted in all directions from the block of iron; the ice was afterwards found, however, to have had sufficient viscosity to support the weight of the shot. It is possible, however, that the piston got jammed in the cylindrical cavity, and thus the ice might not be under the pressure indicated by the gauge. The experiments lead Mr. Wood to the conviction that any theory is questionable that accounts for peculiar motions of glacial ice by supposing the existence of a layer of pressure-molten water beneath the mass.—A review of the Quaternary era, with special reference to the deposits of flooded rivers, by Warren Upham. The Quaternary era, according to many authorities, began with the change from the mild Pliocene climate to that of the Glacial period, has continued to the present time, and must extend far into the future. Mr. Upham traces, in a very concise manner, the succession of events, glacial and fluvial deposits, and the changes in altitude and climate, from the beginning of this era to the present time.—On the illuminating power of flat petroleum flames in various azimuths, by Alfred M. Mayer. The flat flame of a Hitchcock lamp, in which combustion is maintained by a blast of air driven against the flame by a fan moved by clock-work, and the flame of an ordinary petroleum lamp were experimented upon. The latter flame was surrounded by a chimney, the former was not so inclosed. The following is a comparison of the candle-power of each flame at three of the azimuths at which photometric measures were made. The angles were measured from the plane of the flat flame.

Azimuth.		Hitchcok flame.		Ordinary flame.
0°	...	9·8	...	6·6
50	...	15·8	...	10·25
90	...	15·6	...	10·6

It therefore appears that the edges of the Hitchcock flame and the ordinary flame give, respectively, about 37 and 38 per cent. less light than the flat surface.—On the physical properties of hard-rubber or vulcanite, by the same author. The mean of twelve determinations of the coefficient of linear expansion of vulcanite, obtained by means of a specially devised piece of apparatus, gave the value 0·0000636, between the temperature at which the experiments were made, viz. 0° and 18° C. The cubical expansion of the substance is closely represented by the formula—

$$v_t = v_0 + 0{\cdot}000182t + 0{\cdot}00000025t^2.$$

The specific heat = 0·33125. The angle of maximum polarization of a polished surface of vulcanite was found to be 57° 29′. Hence the index of refraction = 1·568. The diathermancy has also been determined.—On some remarkably developed calcite crystals, by Louis V. Pirsson.

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